

VI. *A Description of the Apparatus for making Experiments on the Refractions of Fluids: With a Table of the Specifick Gravities, Angles of Observations, and Ratio of Refractions of several Fluids.*
By Mr Fra. Hauksbee, F. R. S.

THE whole *Apparatus* is fix'd on a Table, parallel to its Surface. On one and the same *Axis* is fix'd a Sextant, of a *Radius* of 4 Feet, and a moving Limb to bear the Object. The Sextant is divided into Degrees and Minutes by a Diagonal, and remains always fixt. The Object, which is plac'd on the moving Limb, is seen parallel with the Table when observ'd through the Prism, and at no Degrees on the Sextant; but when any Transparent Liquid is put into the same, the Object must be elevated till it appears to the Eye: Then observing how many Degrees and Minutes the *Index* on the Limb cuts on the Sextant, we note it, and call it the Angle of Observation. Thus for different Liquids you have different Elevations of the Object, as you will find by the following Table. The Sight-Slit (if I may call it so) is compos'd of two pieces of Box Wood, plan'd parallel to one another: These Pieces are separated only by 3 slender Slips of common Cards; and with that Intervention are screw'd down one upon the other, exactly parallel with the *Axis* of the moving Leg and Sextant. The Prism, thro' which it directs the Sight, is plac'd pretty near it, and consists of an Angle of 44.54, which Angle is fix'd Perpendicular to the Plane of the Table,
its

its upper side being parallel with the same. The Object is a Piece of white Paper, in form of a Cross, pasted on a black Board, and is fix'd at the end of the moving Limb, which is in length about 7 Feet from the Sight ; its Diameter is about $2 \frac{1}{2}$ Inches, which just comprehends the Sight through the Slit ; so that when the Object is wholly within view, we conclude the Observation to be exact. With this *Apparatus* the Experiments are made as well by Candle-light as Day-light, (the Presence of the Sun Beams being no ways necessary) and I think they may be depended on as pretty Accurate. I have taken the Specifick Gravity of the several Liquids, where I could obtain a sufficient quantity, as appears by the Table : So that if any Person should have the Curiosity to repeat these Experiments, he must expect a different Angle of Observation, if the Specifick Gravity agree not with the Table ; for sometimes it happens, that Liquids of the same Denomination are not always of an equal goodness, and consequently will have a different Specifick Gravity and Refraction.

The Chrystalline Humour of the Ox Eye I prest into the Angle of the Prism, whereby it received the form of it, and gave the Angle of Obsertvaion, as specify'd in the Table. I could not see the common Object thro' it, but was forc'd to make use of a Candle for that purpose ; the Flame whereof appeared very broad, at least 5 or 6 Inches, nearly in the form of a Half Moon : But what should occasion such a Change of Figure, I cannot at present determine. Of all the Fluids I have try'd, I find nothing to Refract a Ray of Light less than Water ; yet there are several other Liquids which make the same Angle. I observe Oil of Bees-Wax to be the lightest Fluid, and Butter of Antimony *per Deliquium* to be much the heaviest : The difference of Specifick Gravity between these two Bodies, is as 662 is to 1976, that is, nearly as one to three : And the Ratio

of their Refractions but as 10000 is to 6885 Bees-Wax, so is 5941 Antimony to the same *Radius*; that is, as one to 1.16, or thereabouts. Likewise Oil of Vitriol is in Specifick Gravity to Oil of Sassafras, as 1510 is to 898; yet the *Ratio* of Refraction of the lightest is most considerable, being in proportion as 10000 is to 6475 Sassafras; so is the same *Radius* to 7011 Vitriol. Thus I find, that a Body doth not Refract in proportion to its Specifick Gravity, but from some quality peculiar to its self; whether it be from its Inflammability, or from any different Texture, or Figure of its Component Parts; or whatever else it be, I shall, with the Application of these Experiments, submit to this Honourable Society to determine.

Specifick Gravities in comparison with a bulk of Water e- qual to 820 Grains		Angle of Observation. <i>d. 1</i>	Ratio of Refraction, as 10000 is to
Oil of Sassafras	898	16.50	7485.3
Turpentine	713.5	29.20	6475.8
Bees-Wax	662	25.25	6741.8
Carawayes	662	23.30	6885.4
Oranges	752	26.13	6696.5
Hysop	711	25.20	6741.2
Rosemary	769.5	25.10	6757.6
Savin	747	24.40	6794.7
Origanum	789	25.30	6730.9
Pennyroyal	752	25.00	6770.2
Mint	783	25.30	6730.9
Spike	780.5	26.00	6706.4
Fennel	749	24.30	6807.3
Juniper	798	27.10	6616.5
Cummin	729	25.10	6757.6
Tansey	766.5	27.00	6627.7
Dill	757	23.46	6865.1
	795.5	27.40	6582.7

Oil

Oil of <i>Amber</i>	783	26.30	6662.3
<i>Cinnamon</i>	828	28.40	6517.7
<i>Cloves</i>	827	27.20	6606.8
<i>Nutmegs</i>	759	25.40	6721.4
Spirit of <i>Wine</i>	703.5	18.50	7287.9
<i>Hartshorn</i>	786	17.00	7468.3
<i>Vinegar</i>	824.5	17.00	As <i>Hartshorn</i> .
<i>Sal Armoniack</i>	794.5	16.56	7475.2
<i>Acids</i> , Spirit of <i>Amber</i>	825	16.56	As <i>Sal Armon</i> .
Oil of <i>Vitriol</i>	1510	21.56	7011.5
Spirit of <i>Nitre</i>	1166	20.50	7104.
<i>Aqua Regis</i>	987	19.50	7195.
<i>Aqua Fortis</i>	1157	20.40	7120.5
<i>Aqua Regis</i> from	} 1034	20.10	71615
<i>Aqua Fortis</i> and			
<i>Sal Armoniack</i>			
Butter of <i>Antimony</i>	1976	40.00	5941.3
Spirit of <i>Raw Silk</i>	916	20.30	7135.
Spirit of <i>Honey</i>	716	16.50	As <i>Water</i> .
Tinct. of <i>Antimony</i>	693	18.46	7294.3
<i>Jesuits Bark</i>	720	18.46	As Tinct. of <i>Ant</i> .
<i>Bals. Tolu</i>	717	19.34	7219.3
<i>Gum Amoniacum</i>	719	19.10	7257.3
<i>Mettals</i>	713	18.54	7281.7
<i>Vitreous Humor</i> of	} 16.50	As <i>Water</i> .	
an <i>Oxes Eye</i>			
<i>Christalline Humor</i>	} 24.10		6832.7
of the <i>Ox Eye</i>			
<i>White of an Hens Egg</i>	17.40		7401.3
<i>Jelly of Hartshorn</i>	17.50		7384.7
<i>Human Saliva</i>	16.50	As <i>Water</i> .	
<i>Human Urin</i>	17.05		7451.9
<i>French Brandy</i>	18.20		7338.6

Oil of *Turpentine* strongly ting'd *Green*, with filings of *Brass*, no ways alters its *Refraction*.